

## CLAIMS

1. A silicon single crystal grown by Czochralski method, wherein Cu precipitates do not exist inside the silicon single crystal.

2. The silicon single crystal according to Claim 1, wherein a defect region in the silicon single crystal contains Nv region outside an OSF ring over the entire region in the direction of the crystal growth axis.

3. The silicon single crystal according to Claim 1, wherein a defect region in the silicon single crystal is Nv region outside an OSF ring over the entire region in the direction of the crystal growth axis.

4. The silicon single crystal according to any one of Claims 1 to 3, wherein Cu concentration in the silicon single crystal is less than  $1 \times 10^{12}$  atoms/cm<sup>3</sup>.

5. The silicon single crystal according to any one of Claims 1 to 4, wherein a diameter of the silicon single crystal is 200 mm or more.

6. A silicon wafer produced from the silicon single crystal according to any one of Claims 1 to 5, wherein Cu precipitates do not exist on a surface of and inside the wafer.

7. A silicon wafer produced from the silicon single crystal according to any one of Claims 1 to 5, wherein deformed void defect does not exist on a surface of the wafer.

8. The silicon wafer according to Claim 6 or 7, wherein one part of a defect region in the silicon wafer is Nv region outside an OSF ring.

9. The silicon wafer according to Claim 6 or 7, wherein a defect region in the silicon wafer is Nv region outside an OSF ring in the entire plane of the wafer.

10. The silicon wafer according to any one of Claims 6 to 9, wherein Cu concentration in the silicon wafer is less than  $1 \times 10^{12}$  atoms/cm<sup>3</sup>.

11. An apparatus for producing a silicon single crystal according to Czochralski method, wherein Cu concentration in a component made of quartz to be used in a part in which a temperature in a

furnace for single crystal growth is 1000 °C or more is 1 ppb or less, and Cu concentration in a component made of quartz to be used in a part in which a temperature in a furnace for single crystal growth is less than 1000 °C is 10 ppb or less.

12. The apparatus for producing a silicon single crystal according to Claim 11, wherein devices and components being exposed in the furnace for single crystal growth do not contain Cu as a raw material.

13. A method for producing a silicon single crystal, wherein a silicon single crystal is grown by using the apparatus for producing a silicon single crystal according to Claim 11 or 12.

14. The method for producing a silicon single crystal according to Claim 13, wherein when the silicon single crystal is grown, the silicon single crystal is grown so that a defect region therein contains Nv region outside an OSF ring over the entire region in the direction of the crystal growth axis.

15. The method for producing a silicon single crystal according to Claim 13, wherein when the

silicon single crystal is grown, the silicon single crystal is grown so that a defect region therein is Nv region outside an OSF ring over the entire region in the direction of the crystal growth axis.

16. The method for producing a silicon single crystal according to any one of Claims 13 to 15, wherein when in-furnace components in the furnace for single crystal growth are cleaned, the cleaning is performed in a room environment in which cleanliness is class 1000 or more.

17. The method for producing a silicon single crystal according to any one of Claims 13 to 16, wherein after the silicon single crystal is grown, in-furnace components in the furnace for single crystal growth are cleaned in a room environment in which cleanliness is class 1000 or more, and then, a next silicon single crystal is grown by using the cleaned in-furnace components.

18. The method for producing a silicon single crystal according to Claim 16 or 17, wherein when the in-furnace components are cleaned, cleaning tools and jigs which do not contain Cu as a raw material are used.

19. The method for producing a silicon single crystal according to any one of Claims 13 to 18, wherein the furnace for single crystal growth is provided in a room environment in which cleanliness is class 1000 or more.

20. The method for producing a silicon single crystal according to any one of Claims 13 to 19, wherein after melting of a silicon raw material is finished, it is left for 3 hours or more on a condition that a heating heater is heated with an electric power of 80 % or more of the power in the raw material melting and flow amount of an inert gas introduced in the furnace for single crystal growth is flow amount in the single crystal growth or more.

21. A method for producing a silicon single crystal by Czochralski method, wherein after melting of a silicon raw material is finished, it is left for 3 hours or more on a condition that a heating heater is heated with an electric power of 80 % or more of the power in the raw material melting and flow amount of an inert gas introduced in the furnace for single crystal growth is flow amount in the single crystal growth or more, and

then, a silicon single crystal is grown.

22. A method for producing a silicon single crystal by Czochralski method, wherein when in-furnace components in the furnace for single crystal growth are cleaned, the cleaning is performed in a room environment in which cleanliness is class 1000 or more, and a silicon single crystal is grown by using the in-furnace cleaned components.

23. An apparatus for producing a silicon single crystal according to Czochralski method, wherein devices and components being exposed in the furnace for single crystal growth do not contain Cu as a raw material.

24. An apparatus for producing a silicon single crystal according to Czochralski method, wherein Cu concentration in an observation window made of quartz provided in the furnace for single crystal growth is 10 ppb or less.

25. A method for producing a silicon single crystal by using a combined apparatus of at least two or more of the apparatuses according to Claims 11, 23, and 24.

26. A method for producing a silicon single crystal, wherein a silicon single crystal is grown by a combined method of the methods according to Claims 21 and 22.

27. A silicon wafer produced from a silicon single crystal grown by Czochralski method, wherein density of deformed void defects on a surface of the wafer is 0.01 number/cm<sup>2</sup> or less.